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Economic Assessment of Motorcycle Exhaust Emission Regulations

Energy and Environmental Analysis, Inc, Arlington, Va

Prepared for

Environmental Protection Agency, Washington, D C Office of Mobile Source Air Pollution Control

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The Clean Air Act gives authority to set emission standards for new motor vehicles. The EPA is intending to propose both interim and long term emission standards for motorcycles. The interim standards for 1978 vehicles are believed to be achievable with reasonable development effort and production changes. The long-term 1980 standards will require a more intensive development and testing program. This analysis considers the economic impact of the proposed standards.

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ECONOMIC ASSESSMENT OF MOTORCYCLE EXHAUST EMISSION REGULATIONS

Prepared for:

Environmental Protection Agency
Office of Mobile Source Air Pollution Control
Office of Air and Waste Management

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TABLE OF CONTENTS

A.	Executive Summary	1
	1. Description of the Motorcycle Industry	1
	2. Manufacturers	2
	3. Cost of Achieving Standards	2
	4. Economic Impact	4
	5. Cost-Effectiveness	4
B.	Introduction	7
C.	Description of the Current Industry	10
	1. Scope	10
	2. Nature of the Motorcycle Population	10
	3. Manufacturers	12
	4. Engine Sizes and Types	16
	5. Secondary Products and Services - The After-market	18
	6. Marketing Sector	22
	7. Employment	24
D.	Projected Baseline	26
	1. Expected Growth in New Registrations	26
	2. Effects of Projected Growth in Sales	31
E.	Impacts of Proposed Regulations	34
	1. Potential Impact on Sales and Revenues	34
	2. Consumer Costs	52
	3. Impacts on Competitive Structure	55
	4. Special Impacts - Small Firms	59
	5. Impacts on Product Lines	63
F.	Cost-Effectiveness of Proposed Regulations	67
G.	Impacts of Alternative Regulatory Programs	73
	1. Alternative Standards for Motorcycle Emission Regulations	73
	2. Further Regulation of Alternative Emission Sources	75

LIST OF TABLES

A-1 Cost Assumption for Achieving the 1980 Motorcycle Emission Standards ---------- 3

A-2 Average Expected Impact of Proposed 1980 Emission Standards ---------- 5

C-1 Market Shares in Motorcycle Industry ---------- 13

C-2 Manufacturers with Small Shares of U.S. Motorcycle Registrations ---------- 15

C-3 Share of Market by Engine Size and Type (1972) -- 17

C-4 Product Lines by Four and Two Stroke Models ---- 19

C-5 Current Size of the Aftermarket ---------- 21

C-6 Distribution of Dealers for the Major Manufacturers ---------- 23

C-7 Employment in the U.S. Motorcycle Industry ----- 25

D-1 Population by Age Group, 1960-72, Projections to 1980,1985 ---------- 28

D-2 Projected New Registrations of Motorcycles through 1990 ---------- 32

E-1 Estimated Price Increases Associated with Achieving Motorcycle Emission Standards -------- 37

E-2 1974 Sales of Registered Motorcycles ---------- 38

E-3 Sales of Registered Motorcycles ---------- 39

E-4 Baseline Motorcycle Sales and Revenue Projections 40

E-5 Assumption used to Estimate the Economic Impact - 41

E-6 Impact of 1978 Emission Standard on Sales and Revenues ---------- 42

E-7 Impact of 1980 Proposed Emission Standards on Sales and Revenues ---------- 46

E-8 Average Expected Impact of 1980 Proposed Emission ---------- 47

E-9A Impact of Achieving 1980 Proposed Emission Standards on Market Shares ---------- 48

E-9B Total Capital Cost Through 1982 of the Motorcycle Emissions Standards ---------- 51

E-10 Gasoline Mileage by Motorcycle Engine Size and Type ---------- 52a

E-11 Savings in Operating Costs Due to Emission Controls ---------- 54

LIST OF TABLES

(continued)

E-12 Assessment of Competitive Position of Individual Manufacturers with Respect to the Key Determinants of Impact of Regulations upon Individual Companies ---------- 57

E-13 Production of Some Small and Medium-sized Manufacturers ---------- 60

E-14 Product Line Analysis - Models which are Street Motorcycles ---------- 63

F-1 Cost-Effectiveness of Emission Control Techniques 68

F-2 Cost Effectiveness of Hydrocarbon Control for Motorcycles ---------- 69

F-3 Cost Effectiveness of Carbon Monoxide Control for Motorcycles ---------- 70

G-1 Scenarios for Alternative Motorcycle Emissions Regulations ---------- 74

A. Executive Summary

Section 202 (a) of the Clean Air Act gives the Administrator of EPA the authority to set emission standards for new motor vehicles. The EPA is intending to propose both interim and long term emission standards for motorcycles. The interim standards being proposed for 1978 production year vehicles are believed to be achievable with reasonable development effort and production changes. The long-term 1980 standards will require a more intensive development and testing program. This analysis considers the economic impact of the proposed standards.

1. Description of the Motorcycle Industry

The current population of registered motorcycles is approximately 4.9 million. The growth of this population has been quite rapid over the past ten years. In 1964 approximately one million motorcycles were registered in the United States. By 1970 this figure had increased to 2.4 million. Between 1970 and 1974 the on-the-road motorcycle population grew by roughly 20 percent per year.

A motorcycle serves a dual purpose. It is used both as a recreational vehicle and in many cases as basic transportation. The advantages and disadvantages as a basic form of transportation are fairly obvious. Good fuel economy and ease of finding parking spaces suggest that it would be ideal for the commuter trip while safety and lack of protection from the elements are significant negative factors which limit its use.

Setting emission standards for motorcycles will not affect these basic considerations. The advantages and disadvantages of motorcycles for on-road use will remain substantially unchanged. The major economic impact of emission standards will be the additional cost incurred by the manufacturers and associated higher purchase price to consumers.

2. Manufacturers

Four Japanese companies dominate the industry. Honda accounts for roughly 43 percent of total sales, with Suzuki, Kawasaki, and Yamaha having a relatively equal percentage of the market. The only major domestic manufacturer is Harley-Davidson, accounting for about six percent of the total number of motorcycles sold each year.

3. Cost of Achieving Standards

Estimates of the cost of achieving both the interim 1978 standards and the long term 1980 standards are highly uncertain. Since no standards exist the manufacturers have only performed a limited amount of research and development. The proposed interim standards were deliberately set at levels that were considered achievable with a minimum of disruption. The 1980 standards are expected to be more difficult to achieve, but attainable. Cost estimates for the 1978 standards range from $20 to $40 per motorcycle. For the purpose of this analysis, we have assumed that the cost would average $30. Estimates for 1980 are subject to considerably more uncertainty.

The 1980 standards may require substantial modifications of engine designs and/or the addition of hardware such as catalytic converters. Honda, as a result of their automobile emission control program is considered to have an advantage over other manufacturers. Given the degree of uncertainty regarding the cost of achieving the 1980 proposed emission standards, three cost estimates were used. Table A-1 shows the range of cost estimates employed. Case 1 is intended to represent the cost if all manufacturers are able to meet the standards through engine modification. Case 2 represents the cost if catalytic converters are required. Case 3 represents the cost if Honda is able to perfect its stratified charged engine design, while all other manufacturers are forced to use catalytic converters.

TABLE A-1

COST ASSUMPTION FOR ACHIEVING THE 1980 MOTORCYCLE EMMISSION STANDARDS

		$/Motorcycle
Case 1		$ 50
Case 2		$ 130
Case 3	Honda	$ 50
	Others	$ 130

4. Economic Impact

The economic impact on the industry will depend on the response of consumers to higher prices. In order to estimate the impact, growth projections were made based on the current market outlook for new motorcycle sales through 1980. These projections were then modified to reflect the demand for motorcycles at the higher prices associated with achieving the emission standards. Consumer reaction to higher price was estimated using two price elasticity of demand[1/] assumptions. For the high side, unit price elasticity was chosen, i.e. 1.0. For the low side, a price elasticity of 0.3 was chosen. The high price elasticity estimate would tend to support the view that motorcycles are a basic form of transportation. The low elasticity estimate would tend to imply that motorcycles are leisure products. The mid-range of the estimated economic impact is shown in Column 1 of Table A-2. Column 1 corresponds to the price assumptions in case 3 (Table A-1) and a price elasticity of demand of around 0.7. Unit sales under these assumptions would be expected to decrease from the baseline projection by approximately 7.1 percent, revenues to increase by 2.0 percent, and the average price to increase by around 10 percent. Column 2 represents the range over which the actual impact might fall. The total cost of compliance over the five year period 1978-1982 is also shown. The five year cost of this program should be about $500 million.

5. Cost Effectiveness

The cost effectiveness of controlling motorcycles can be compared to other techniques which reduce HC and CO emissions from light duty vehicles and gasoline stations. In terms of kilograms controlled per dollar spent, the cost effectiveness of controlling motorcycles relative to the cost effectiveness of controls on LDV's varies depending on the motorcycle engine size and type.

1/ "Price elasticity of demand" is a unitless measurement of the sensitivity of consumer buying to a change in unit price. It is equal to the percentage change in unit sales divided by the corresponding percentage change in unit price.

TABLE A-2

AVERAGE EXPECTED IMPACT OF

PROPOSED 1980 EMISSION STANDARDS

	(1) Average	(2) Range
Unit Sales (10^3 units)	1,343.3	1,233.4 to 1,421.0
% Change from Baseline	-7.1	-14.7 to -1.7
Revenues (10^6 $)	$1,636.8	$1,572.3 to $1,723.1
% Change from Baseline	+2.0	- 1.7 to + 7.7
Average Cost ($/unit)	$1,219.0	$1,161 to $1,275
% Change from Baseline	+10.1	+ 4.9 to +15.2
Total Cost 1978-1982[1/] ($10^6$$)	$502.9	$304.5 - $665.3

1/ Aggregate cost of emission control systems over the period 1978-1982.

It should be noted that the motorcycle modifications being considered will yield reductions in both pollutants. However, it is not possible to determine the cost of controlling only one of the pollutants. Therefore, in calculating cost-effectiveness, the fuel price of the emission control system has been used as the cost of controlling hydrocarbons and also as the cost of controlling carbon monoxide. It should be noted that, in this analysis, it has been assumed that the cost of meeting the standards does not vary with engine type or engine displacement and that this cost is passed forward to the consumer equally for each class of motorcycles. This assumption is used here since data is not available with which to quantify any likely cost differences. It may cost somewhat less to control four-stroke engines than two-stroke engines and it may cost somewhat less to control the smaller displacement engines than the larger displacement engines. Lacking the data with which to quantify these likely differences, the following conclusions are based on the equal cost assumption.

For the 1978 standards, control of HC emissions from 2-stroke motorcycles larger than 170 cc is more cost effective than any of the LDV techniques considered. Control of HC alone (although in fact modifications will control both HC and CO) from 2-strokes smaller than 170 cc is more cost effective than LDV catalysts, but less cost effective than air bleed retrofit on LDV's. Control of CO for motorcycles larger than 170 cc is more cost-effective than all LDV techniques considered except air bleed.

For 1980 standards, the cost effectiveness of motorcycle regulation relative to LDV control options depends on the cost of the motorcycle modifications. Exact cost estimates cannot yet be made, but at either a $50 to $130 cost, control of 4-stroke motorcycles less than 170 cc would not be cost effective compared to the LDV control techniques considered. For large 2-strokes, a cost of $50 for 1980 modifications would make their control cost effective for HC reduction relative to all the LDV programs considered. A $100 cost would make them less cost effective than gasoline station controls or vacuum spark advance disconnect on LDV's. Control of other sizes and types of motorcycles have varying cost effectiveness relative to LDV techniques. The cost effectiveness depends on the pollutant being controlled and the cost assumed for modifications.

B. Introduction

Section 202(a) of the Clean Air Act gives the Administrator of EPA the authority to set emissions standards for new motor vehicles and motor vehicle engines which, in his judgment, cause or contribute to air pollution which endangers the public health or welfare. This Section further prescribes that such regulation shall take effect after a period necessary to permit the development and application of the requisite technology.

Section 213 of the Act defines "motor vehicle" as "any self-propelled vehicle designed for transporting persons or property on a street or highway." This definition clearly includes motorcycles licensed for operation on highways. However, Section 85.001 of 40 CFR Part 85 presently excepts motorcycles from the regulations which apply to light duty vehicles.

The EPA is intending to propose both interim and long-term emission standards for motorcycles. The interim standards being proposed for the 1978 production year are expected to be achievable with reasonable development effort and production changes. The hydrocarbon phase-in standard is dependent on engine displacement, and will require control of HC to 5 grams per kilometer for motorcycles between 50 cc and 170 cc. The standard increases proportionately with displacement from 5 g/km at 170 cc to 14 g/km at 750 cc. The 14 g/km level applies to all motorcycles with displacements in excess of 750 cc. Standards for 1974 are also set for CO at 17 g/km and for NO_x at 1.2 g/km.

Long-term standards are being proposed which would have to be met by the 1980 production year. Emission standards for 1980 and later model years are proposed to be set at the same

level in effect for light duty vehicles for those years.

This analysis will determine the costs of achieving these reductions. Costs will be interpreted to include both direct and indirect costs to producers and consumers. An evaluation will be made of both cost per motorcycle and aggregate costs.

The regulations will have potential effects on the growth and competitiveness of the industry, and these effects will be evaluated. Any factor which causes a general rise in the price of motorcycles may be expected to cause a decrease in the quantity of motorcycles demanded. However, not all manufacturers will be faced with the same costs of meeting the proposed standards, and percent reductions in sales due to price increases may not be the same for all manufacturers. The emissions characteristics of two-stroke and four-stroke engines are considerably different. For either interim or long-term standards, the costs of controlling these emissions may vary between manufacturers, and especially between the type of engine being controlled. Manufacturers have considerably different model lines, ranging from all four-stroke engines to all two-stroke engines. In the highly competitive motorcycle market, a manufacturer faced with larger than average price increases due to addition of control systems can potentially lose a large share of his market. Manufacturers also vary greatly in size, and size will be an important determinant of ability to meet the standards.

The current structure of the industry will be considered in detail. Size of manufacturers, market shares, and nature of product lines will be considered in order to establish areas where the regulations may potentially have different effects on different manufacturers. The nature of the marketing and secondary product sectors are characterized in order that the breadth of potential impact can be defined.

A projection of this baseline industry will be made, and the effects of the regulatory program on producer costs and consumer costs will be evaluated. A cost-effectiveness comparison will be made between motorcycle regulations and other control strategies. The economic impact of alternative regulatory programs will also be discussed.

C. Description of the Current Industry

1. Scope

The proposed regulations apply only to registered motorcycles which are licensed for operation on streets. This study will deal only with these registered motorcycles, although motorcycles which are used only off-road are a significant portion of the current population and are important in the annual sales figures of the industry.

2. Nature of the Motorcycle Population

The current population of registered motorcycles is approximately 4.9 million.[1/] The recent growth of this population has been extremely rapid. The population of registered motorcycles was only about one million in 1964, and was 2.4 million in 1970. From 1972 to 1973, new registrations increased 18.3 percent. However, in 1974, the number of new registrations dropped 13.7 percent from the 1973 figure.[2/] This levelling-off of the sales of motorcycles is a new phenomenon and is related to both general economic conditions and rapidly increasing prices for motorcycles in the last two years. Certain regional markets may also be exhibiting first signs of partial saturation. Figure 1 shows the recent trend in new registrations. Data on new registrations can be used to approximate sales of new registerable motorcycles for each year.

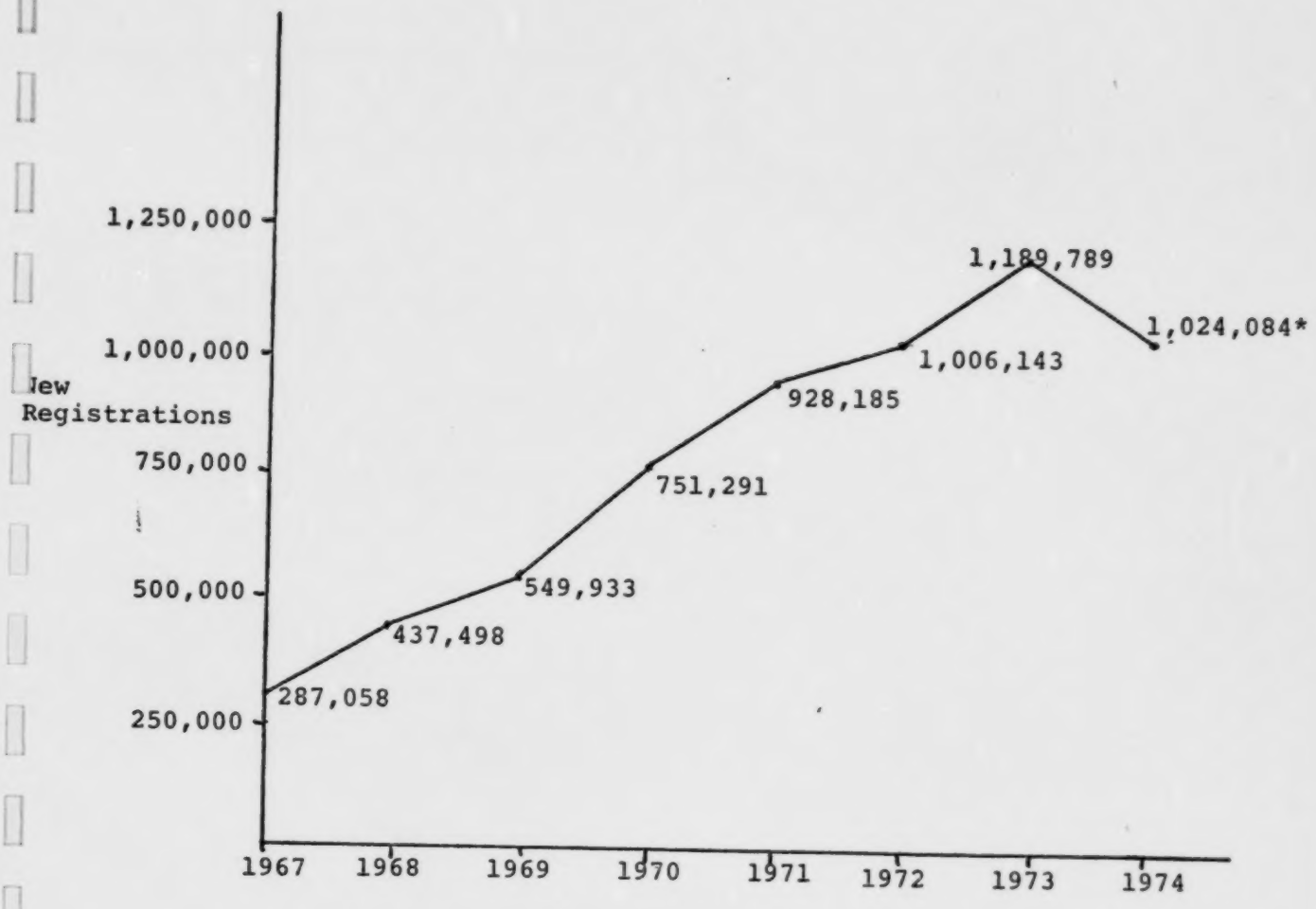
There were few motorcycles in the United States in 1960 when Honda began selling motorcycles in the American market.

1/ Federal Highway Administration estimate, September, 1974.

2/ The drop in new registrations does not mean that total registration decreased. Rather, between 1973 and 1974, total registrations increased by 14.1% since new registrations significantly exceeded the number of motorcycles which were scrapped or retired from the road.

FIGURE 1

NEW U.S. MOTORCYCLE REGISTRATIONS



* Adjusted to include estimate for incomplete Ohio registrations

Source: Motorcycle Industry Council

The subsequent advertising and promotional campaign addressed to people who had not previously ridden motorcycles helped to create the present market. A change in the image of motorcycles has occurred, and today nearly 54 percent of the owners are married, 42 percent of them are college educated, and the average family income is about $15,000.[1/]

The motorcycle has the dual role of being both a recreational product and a basic form of transportation. The fuel economy of motorcycles ranges from 90 miles per gallon for small four-stroke motorcycles to 35-40 miles per gallon for motorcycles over 300 cc.[2/] Certain basic characteristics of motorcycles, such as exposure to weather and the coordination necessary for operation, have limited widespread use of motorcycles for transportation in the U.S. where most people can afford automobiles.

Motorcycles registered for street usage are purchased by people who are looking for an inexpensive form of transportation and/or a recreational product. A large number of buyers view the motorcycle as both a recreational and transportation product. A recent study of motorcycle usage shows that half the motorcycles ridden on the street are used to commute to work or school. According to those surveyed, pleasure riding in town is a primary or secondary use of 67 percent of motorcycles ridden in the street.[3/] This dual function of motorcycles is confirmed by a recent Gallup study of motorcycle usage.

1/ Motorcycle Usage Study, August 1973, Motorcycle Industry Council.

2/ Based on EPA tests. See Table E-10.

3/ March 1974 Motorcycle Usage and Owner Profile Study, Hendrix, Tucker and Walker, Inc.

3. Manufacturers

The motorcycle industry can be divided into two sectors: a production sector and a marketing sector. The production sector consists of suppliers of components and manufacturers of motorcycles. Most manufacturers not only assemble the motorcycles, but also make some or most of the components. The suppliers market is quite large, and is of importance because of its size in the United States.

The part of the production sector which manufactures motorcycles is quite concentrated. As shown in Table C-1, the top four producers are Japanese companies. Their motorcycles account for nearly 87 percent of the new registrations in the United States. No company outside of the top five manufacturers produces more than two percent of the market. The top American manufacturer is Harley-Davidson with about six percent of the new registrations. Some of its motorcycles are manufactured in Italy.

Although the top ten manufacturers produce about 96 percent of all motorcycles registered, there are a number of smaller producers who supply the other four percent of motorcycles. The market shares of U.S. motorcycles in all cases are small. No manufacturer in this small manufacturer category has even 0.5 percent of the total U.S. motorcycle registrations. It is important to note, however, that some of these "small" producers are large manufacturers and suppliers for a foreign market.

TABLE C-1

MARKET SHARES IN MOTORCYCLE INDUSTRY[1/]

	1974	1973	1972
Honda	42.91	42.12	47.71
Yamaha	20.28	20.29	17.91
Kawasaki	12.82	12.06	9.28
Suzuki	10.73	12.87	12.35
Harley Davidson	5.73	4.97	4.32
BMW	.89	.56	.52
Hodaka	.78	.72	.68
Norton[2/]	.70	.53	.60
Triumph[2/]	.68	2.33	2.09
Bultaco	.42	.36	.45
Total of Top Ten	95.94	96.81	95.91

1/ based on new motorcycle registrations

2/ Polk data shows Norton and Triumph separately. They are now merged and called Norton-Triumph

Source: Motorcycle Industry Council based on data from R. L. Polk and Co.

Table C-2 shows a listing of a number of the manufacturers with very small shares of the U.S. market. Many of these manufacturers make off-road and trail bikes. An inclusion of manufacturers of mini-bikes would include a large number of manufacturers. Some of these, such as Alsport Steen, Chapparel, Speedway and Rupp are American manufacturers whose production shows up, at least in part, in the R.L. Polk and Company data on motorcycle registrations.[1/] It is not possible to determine which of the motorcycles in the mini-cycle and off-road categories are registered if they do not show up in the Polk data. Some of the small manufacturers not listed in Table C-2 may make motorcycles which are basically off-road or trail motorcycles but which may be registered. This number is not known, however, and is thought to be small. Unless registration data is used as a proxy for sales of on-road motorcycles, no estimate of what percentage of total motorcycles are on-road can be accurately made.

A large number of small producers manufacture exclusively off-road motorcycles. These producers will not be directly affected by the proposed emission regulations and they are not being considered. However, a relatively high turnover of small manufacturers means that some manufacturers may enter the registered motorcycle market which are not listed in Table C-2 . The successful companies among these small producers generally produce a specialized product which is often of very high quality and is aimed at a small market.

A very large percentage of the registered motorcycles in the United States are produced by foreign manufacturers. Table C-1 shows that 89.8 percent of the registered motorcycles are produced by foreign manufacturers in the group

1/ "New Motorcycle Registrations", December 1974, compiled by R. L. Polk & Co.

TABLE C-2

MANUFACTURERS WITH SMALL SHARES OF U.S. MOTORCYCLE REGISTRATIONS

Manufacturer	Share of New 1974 Registrations 1/ (%)	Country of Origin	Product Line 2/
Ducati	.10	Italy	2 street models
Husqvarna	.31	Sweden	3 off-road models
Jawa/CZ	.37	Czech.	2 models, off-road also
Moto Guzzi	.27	Italy	2 street models
Ossa	.19	Spain	4 models, off-road also
Bombardier	*	Canada	2 models, off-road also
Cooper	*	Mexico	1 model, off-road also
DKW	*	Germany	3 models, off-road also
Laverda	*	Italy	3 street models
Montessa	*	Spain	1 model, off-road also
Penton	*	Austria	4 models, off-road also
Puch	*	Austria	1 model, off-road also
Rickman	*	England	1 model, off-road also
Rockford	*	Japan	3 models
Rokon	*	U.S.A.	1 model, off-road also
Yankee	*	Spain	1 model
Zundapp	*	Germany	1 model, off-road also

1/ Market shares as shown in R. L. Polk data for new registrations. Those with asterisk do not have separate listings in Polk data.

2/ Number of models which are classified as "street" or "street & trail". If company also produces off-road motorcycles, this is noted. Some motorcycles which are classified as off-road may be registered by their owners. Some mini-bikes are registered. Polk data shows 3 U.S. manufacturers of mini-bikes: Rupp, Steen & Chaparrel. A substantial number of other small domestic and foreign mini-bike manufacturers produce bikes which may be registered by their owners.

SOURCE: Petersen's Motorcycle Buyer's Guide, 1974.

of the nine largest firms. Table C-2 shows that most of the small manufacturers who produce 4 percent of registered motorcycles are also foreign producers. The number of imported motorcycles can be derived either from Department of Commerce data on imports (which will include approximately 30 percent off-road motorcycles) or from Polk data on registrations. Based on Polk data, 969,000 registered motorcycles were imported in 1974 with 1,148,000 in 1973 and 972,000 in 1972. The retail value of imports in 1974 was approximately $1,008,000,000.[1/] Exports are very small, and were worth only about $3.8 million in 1971.

4. Engine Sizes and Types

Different engine sizes and especially different engine types have different emission characteristics and will, in some cases, require different control technologies. Table C-3 shows the share of market by engine size and type.

For motorcycles less than 100 cc, the share of 4-stroke engines has decreased considerably since 1967. The share of all motorcycles less than 100 cc has decreased from 32.5 percent in 1967 to 17.5 percent in 1972. For motorcycles between 100 and 200 cc, the share of total registrations increased slightly in the five year period 1967-1972. The share of 2-strokes in this size category has fluctuated around 15 percent of total registrations, and the share of 4-strokes has increased somewhat.

The share of motorcycles in the engine size categories larger than 200 cc has increased from about 43 percent in 1967 to 54 percent of total new registrations in 1972. A

1/ R.L. Polk & Co. data. Total arrived at by subtracting U.S. motorcycles from total registrations. Value of imported motorcycles was determined from Petersen's Motorcycle Buyer's Guide.

TABLE C-3

SHARE OF MARKET BY
ENGINE SIZE AND TYPE (1972)

	Percentage of Total Market		
	2-stroke	4-stroke	Total in each size class
Less than 100 cc	7.5	10.0	17.5
100 - 199 cc	15.8	12.3	28.1
200 - 299 cc	6.6	1.9	8.5
300 - 599 cc	9.3	23.6	32.9
600 and over	1.4	11.6	13.0
Total in Each Engine Type	40.6	59.4	100

Source: Motorcycle Industry Council

number of manufacturers have expanded their lines to include models of large (greater than 300 cc) engine size.[1/] Table C-4 shows the model lines of different manufacturers by engine type. Honda is basically a 4-stroke manufacturer, Suzuki makes entirely 2-strokes (with a rotary engine introduced in 1975) and the other manufacturers have mixed lines. Sales in these various categories will be discussed later.

Two-stroke engines are popular for several reasons. They are generally less expensive than four-stroke motorcycles of comparable power (although not necessary comparable displacement). In addition, consumers may view the 4-stroke engine as a more complex system although many 2-strokes are equally technically sophisticated. There is a broad spectrum of engine sizes and types available on the market today. They range from highly sophisticated multi-cylinder double overhead camshaft four-stroke engines to simple, single cylinder two-stroke engines.

The manufacturing of motorcycles domestically has already been shown to account for only a small portion of motorcycles sold in the United States. The manufacturers of accessories and various components for the aftermarket are largely American companies.

5. Secondary Products and Services - The Aftermarket

The aftermarket represents a sizable direct domestic involvement in the motorcycle industry, and as such provides an important source of employment and income to the United States. Approximately 1,500 separate companies are engaged in the manufacture and/or distribution of literally thousands of aftermarket products.

1/ "The Impact of Noise Abatement Standards Upon the Motorcycle Industry," IR&T Corp.

TABLE C-4

PRODUCT LINES BY FOUR AND TWO STROKE MODELS[1/]

Manufacturer	Total Models	of Total Models		of Only Street and street/trail	
		2-stroke	4-stroke	2-stroke	4-stroke
Honda	32	5	27	5	19
Yamaha	23	20	3	9	3
Kawasaki	17	15	2	11	2
Suzuki	22	22	0	15	0
Harley-Davidson	11	5	6	3	6
Norton/ Triumph	3	-	3	0	3
Benelli	13	9	4	8	4
BMW	3	0	3	0	3

1/ Includes only major manufacturers, 1974 model lines. (1975 model lines expected to have a slight shift to 4-strokes by Kawasaki and Yamaha)

SOURCE: Petersen's Motorcycle Buyer's Guide, 1974.

Over the past two to three years, the market for replacement parts and accessories has grown at a rate of 40 to 50 percent annually. For 1974, aggregate demand for aftermarket products and services totalled approximately $1.8 billion. Table C-5 breaks this out by major segments of the aftermarket.

Unlike the original-equipment-manufacture (OEM) portion of the industry, foreign manufacturers do not dominate the aftermarket. The majority of aftermarket products are manufactured in this country with the exception of most replacement parts which are imported by the various manufacturers. The sales concentration ratio within this segment of the industry is low. The competitive structure is one of many small firms, with each supplying a small percentage of total sales.

In light of the major role of foreign manufacturers in the market for new motorcycles, only about 45-55 cents of each dollar sales is likely to be retained in this country.[1/] With respect to the percentage of each aftermarket sales dollar which flows into the domestic economy, as high as 80-90 cents may be retained. This reflects the very small role of imported products in this segment.

Using these assumptions of percent retained in the United States, the $1.6 billion of sales of original equipment in the U.S. would represent about $800 million in retained value for the U.S. economy. The $1.8 billion of aftermarket sales would represent about $1.5 billion in retained value to the U.S.

1/ This estimate reflects retailer margins, the fact that most of distributor's mark-up is in essence retained in the form of expenses, with only a small portion passed back to the parent company, and the duty paid to the U.S. government.

TABLE C-5
CURRENT SIZE OF THE AFTERMARKET[1/]

Category/Segment	$ Sales (retail)
Replacement Parts	250,000,000
Accessories	670,000,000
Service Receipts/Repair	450,000,000
Insurance	385,000,000
Miscellaneous (consumer publications, etc.)	50,000,000
TOTAL:	$ 1,805,000,000

1/ Inclusion of gasoline, oil, taxes, fees, tolls, and parking would bring the total to about $2.4 billion.

Estimates based upon data from the Motorcycle Industry Council and MOTORCYCLE DEALER NEWS.

6. Marketing Sector

The other major portion of the industry is the marketing sector. This sector consists of dealers and distributors. Some small (and often off-road) manufacturers sell directly to dealers, but the major manufacturers distribute their motorcycles to franchised dealerships through owned distributors. The rapid growth of the industry has meant that some manufacturers are still establishing marketing systems. In certain areas of the country, especially in the South and Southwest, dealers are relatively scarce and both sales and services are limited in these areas.

There are about 8,000 dealers in the United States. Table C-6 shows the number of dealers for the major manufacturers. The distribution used by the smaller manufacturers varies. Some use distributors, and a smaller manufacturer often sells to dealers who carry several lines of motorcycles. Estimated total sales volume for all dealers in 1973 was $2,525,000,000. Dollar volume of sales is about $350,000 per year for the average dealer. Total retail sales volume varies greatly. While about 46 percent of the dealers have retail sales between $100,000 and $500,000 per year, about 21 percent of the dealers have retail sales of less than $50,000, and about 5 percent are over one million dollars per year in total retail sales volume. The average number of employees per dealer is 8. This includes both full-time and part-time, and includes sales personnel, mechanics, and others.[1/] Sales of new motorcycles account for about 52 percent of retail sales for a typical dealership. Sales of parts (8%), accessories (14%), and used motorcycles (10%), as well as service (16%) account for the balance.

1/ Motorcycle Industry Council: Facts and Figures

TABLE C-6
DISTRIBUTION OF DEALERS FOR THE MAJOR MANUFACTURERS

Manufacturer	Number of Dealers
Honda	1,800
Yamaha	1,200
Suzuki	1,200
Kawasaki	1,000
Harley-Davidson	600
Norton/Triumph	800

There is substantial employment in the production and marketing sectors. Employment is not only in the manufacturing and sales sector, but also in support industries which essentially manufacture aftermarket products.

7. Employment

Manufacturers were discussed briefly as a part of the discussion of market shares. The four Japanese firms account for about 87 percent of sales of on-road motorcycles. Kawasaki has just opened an assembly plant in Lincoln, Nebraska, but, except for this one plant, all Japanese motorcycles are manufactured and assembled in Japan. Harley-Davidson is the largest American manufacturer and of its models, only the large motorcycles are produced within the United States; the rest are manufactured in Italy. The four European companies in the top ten produce about 3 percent of the registered motorcycles and their manufacturing is in Spain, England and Germany. The small manufacturers have been listed above, and it was noted that only a small percentage of registered motorcycles are manufactured in the United States. Manufacturing of accessories and components sold as a part of the aftermarket is of greater importance for domestic employment than is the manufacturing of actual motorcycles. Table C-7 shows an estimate of domestic employment in the motorcycle industry. Employment related to only off-road motorcycles is estimated at about 20 percent of the total.

TABLE C-7

EMPLOYMENT IN THE U.S. MOTORCYCLE INDUSTRY

Segments	Total
OEM Manufacture, Distribution, Sales Forces:	
-total employment associated with the manufacturer(Harley-Davidson), importing (distribution, and sales efforts) of all full-sized motorcycles sold in this country. Does not include several small U.S. manufacturers who sell exclusively off-road motorcycles and mini-bikes	3,500
Aftermarket - Manufacture,Distribution:[1]	
Manufacture-	
-there are about 1,300 individual companies manufacturing products supplied to the aftermarket;	
-average number of employees is 19 associated with motorcycle related product sales	24,700
Distributors-	
-approximately 250 companies who distribute aftermarket products to retail outlets	
-average number of employes is 10	2,500
Retail Outlets:[2]	
Franchised Dealerships	
7,250 x 8 (ave. # of employees)	58,000
Non-franchised	
(parts and only accessory shops, service shops, custom chopper shops)	
1,250 x 4	5,000
Miscellaneous	
-publishers	
-insurance, credit & financing, services	
-mechanics schools	
-other assorted businesses	2,000
TOTAL	95,700 [3]

Estimated employment in on-road motorcycle industry = 76,500[3]

1/ Source: 1974 Frost & Sullivan Aftermarket Survey-Management Summary

2/ Source: MOTORCYCLE DEALER NEWS

3/ includes both full-time and part-time employees

D. Projected Baseline

1. Expected Growth in New Registrations

Figure 1, cited in section C.2 above, shows the historical progression of new motorcycle registrations. Both new registrations and the total population of registered motorcycles have recently experienced very rapid growth. Between 1967 and 1970, new registrations (which approximate sales of new on-road motorcycles) grew at a very rapid 37.8 percent per year. From 1970 to 1974 the growth rate slowed to an average rate of 8.1 percent per year. New registrations in 1974 dropped 14 percent from the 1973 level. In projecting the population of motorcycles, the exceptional growth rate in sales and total population of the late 1960's should not be extrapolated to the 1980's because the market has changed in nature greatly from those years. A number of factors need to be considered when projecting motorcycle sales and population; these are briefly outlined below. Some of these factors are positive influences on the growth in sales, while others are negative influences on sales. In arriving at a growth estimate, it is necessary to take into account the strength of these various factors.

The price of the product has experienced very rapid increases recently. Almost 90 percent of the motorcycles sold come from Japan and the extremely rapid rises in the costs of oil, steel and labor in the Japanese economy have greatly affected the price of motorcycles sold in the United States. A continuation of current Japanese economic trends could lead to rapidly increasing motorcycle prices relative to American price indices. All other factors being equal, large increases in the initial purchase price for motorcycles imply reductions in demand. Although recreational buyers are generally not extremely price sensitive, some reduction in sales of motorcycles to recreationally-oriented buyers could be expected.

Price increases will also make the motorcycle less attractive as transportation when compared to the automobile. Since the automobile is to some degree a substitute for motorcycles, exact effects of motorcycle price increases will necessarily depend on the simultaneous price trends for automobiles. Rapidly increasing motorcycle insurance costs represent an operating expense which will also tend to discourage new sales.

Shifts in population age groups represent an important factor in any evaluation of the future growth of sales relative to historical trends. For motorcycle sales, the size of the age group from 20-34 is currently most important for on-road motorcycles. Off-road motorcycles are dependent on sales to the younger, 16-24, age group. As can be seen in Table D-1 , the annual growth rate of the 20-34 age group from 1972 to 1980 is expected to average a rapid 3 percent per year. This rate slows to a rate of growth of 1.1 percent per year from 1980-1985. These rates of growth are a good indicator of more rapid growth of motorcycle sales in the short run (to 1980), with less rapid growth after 1980. Sales are expected to increase faster than the national growth rate of just this one age group, however. Certain regional markets, such as the South and Southwest, may grow more rapidly than the national average due to the present low per capita registrations in these areas.[1/]

1/ The Impact of Noise Abatement Standards Upon the Motorcycle Industry, IR&T Corp.

TABLE D-1

POPULATION BY AGE GROUP, 1960-72, PROJECTIONS TO 1980, 1985

	Number of People (millions)				Average Annual Percent Increase		Percent Distribution			
	1960	1972	1980	1985	1972-80	1980-85	1960	1972	1980	1985
Under 16	58.9	60.9	56.8	60.0	0.8	1.1	32.6	29.2	25.4	25.5
16-19	10.7	15.9	16.4	14.0	0.4	3.2	5.9	7.6	7.3	6.0
20-34	34.0	45.6	58.0	61.2	3.0	1.1	18.8	21.8	25.9	26.0
35-54	44.8	46.4	47.8	53.2	0.4	2.1	24.8	22.2	21.3	22.5
55 and over	32.3	40.0	45.1	47.3	1.5	1.0	17.9	19.2	20.1	20.0
TOTAL	180.7	208.8	224.1	235.7	0.9	1.0	100.0	100.0	100.0	100.0

SOURCE: Bureau of Labor Statistics Review, December 1973.

Considerations of safety have somewhat dampened the growth in popularity of motorcycles from the late 1960's. Motorcycles are a relatively less safe form of on-road transportation than the automobile with a fatality rate almost four times greater than that for automobile drivers and passengers.[1/] Increasing media coverage of these dangers has served to make many potential buyers wary of purchasing a motorcycle for street use. Safety is a crucial issue in the motorcycle industry, and a vigorous safety campaign by a government agency or a consumer group could have a negative impact on demand.

Because motorcycling is partly a recreational activity, it will be affected by a number of forces that may potentially affect demand. A trend toward an increasingly shorter work week and the positive effect this has on sales of recreational products implies a rate of growth in sales which is greater than the growth rate in population. Higher income groups, with their greater discretionary incomes, are large purchasers of motorcycles. Trends towards fewer children per family suggest increases in discretionary incomes, with a positive effect on new registrations. Increased sales to women represent a vast untapped market which provides a possibility for a growth rate for motorcycles which exceeds the growth rate of population. The changing role of women in our society can contribute to growth of this large potential market.

A massive shift in the role of motorcycles as transportation in the United States could imply an extremely high growth rate of motorcycle sales. The fuel economy advantages offered by this product will provide a definite positive stimulus to

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1/ Based on National Safety Council Statistics: in 1972 deaths per one hundred million miles traveled were 4.7 for all motor vehicles and 18.0 for motorcycles only.

demand. However, a massive shift to motorcycles as a form of basic transportation for a large percentage of the U.S. population seems unlikely for several reasons. Such basic product characteristics as exposure to climate, limited carrying capacities, risk of operation, and the coordination required for operation will limit the potential for mass use as a transportation vehicle. A trend towards manufacture of compact and sub-compact cars by Detroit will be likely to provide a more attractive substitute to motorcycles for many who desire economical transportation. As a transportation vehicle, motorcycles can be expected to increase in popularity with rapid increases in fuel costs. However, this possibility should not be overstated for the reasons outlined above.

The activities of the large manufacturers of motorcycles suggest that they do not view the American market as having the potential it had in the late 1960's for extremely rapid growth. They are actively committing their resources to developing alternative markets in Africa, South America and the Middle East. Nevertheless, the American market is certainly not saturated, and a growth rate should be chosen which reflects this fact.

While recent slumps in sales may be an indication of factors at work besides short-term economic conditions, it is felt that there is still potential for considerable growth in sales of motorcycles. It is estimated that 1975 sales could be lower than 1974 sales, and that at best they will equal 1974 levels. It is assumed here, based on an evaluation of both the positive and negative factors influencing growth, that the market responds in 1976 and resumes a 1970-1974 growth rate of 8 percent per year. This growth rate is assumed to continue until 1980 when a decrease in the growth rate to about

4 percent per year through the 1980's is assumed. Annual new registrations through 1990 implied by these growth rates are shown in Table D-2.

2. Effects of Projected Growth in Sales

The increases in new registrations shown in Table D-2 imply increases in employment, dollar sales, and the aftermarket. It is not expected that market shares will change drastically in the time frame being considered here. Changes in market shares will occur, of course, but no major shift towards mass sales by American producers or erosion of the current market power of Japanese manufacturers is expected. For simplicity of analysis, and absent data to the contrary, it is assumed that market shares remain as they were in 1974. As a baseline projection, no major shifts in sizes of motorcycles or engine types are projected.

Employment in manufacturing, given that no major labor-saving technologies are developed, can be expected to increase at about the same rate as the growth in new registrations. However, as was pointed out earlier in the baseline characterization of the industry, manufacturing is not a major source of domestic employment. A new manufacturing plant for Kawasaki motorcycles has just opened in Nebraska. However, the Japanese manufacturers have indicated that they expect no major changes involving production in the United States, and most increases in manufacturing employment will occur in Japan. The aftermarket is of greater importance for domestic employment and it is expected to grow faster than the rate of growth in new registrations. Sales of aftermarket products (parts and accessories only) are expected to grow at a much

TABLE D-2

PROJECTED NEW REGISTRATIONS OF
MOTORCYCLES THROUGH 1990

Year	New Registrations (millions of units)	Percent Increase over Previous Year
1974	1.01[1/]	--
1975	1.01	0
1976	1.09	8
1977	1.17	8
1978	1.27	8
1979	1.37	8
1980	1.43	4
1981	1.49	4
1982	1.55	4
1983	1.60	4
1984	1.67	4
1985	1.73	4
1986	1.81	4
1987	1.88	4
1988	1.96	4
1989	2.03	4
1990	2.12	4

1/ Based on R. L. Polk data on New Registrations.

stronger rate than new motorcycle sales over the period 1975 through 1980. In constant dollar terms, the annual growth rate is expected to exceed 30 percent. During the 1980's, it is expected to slow to 10 per cent per year.1/

This fast rate of growth of the aftermarket will imply increases in domestic employment and total sales of motorcycle-related products. As noted in the discussion of the baseline aftermarket, it is this sector (along with dealers and distributors) which is of greatest importance to the American economy. The marketing sector can be expected to grow at about the same rate as the growth in sales although it should be noted that since the major manufacturers already have distributors established, employment by distributors could grow at less than the rate of growth of sales. Regional growth of sales in the South and Southwest may tend to increase this growth rate of retail employment, and the net effect of these two trends will probably be that domestic employment in the marketing sector will grow at about the same rate as growth in sales.

1/ From a summary of extensive analysis of the aftermarket performed by Frost and Sullivan.

E. Impacts of Proposed Regulations

1. Potential Impact on Sales and Revenues

This section addresses the potential impact of emission control standards on sales and revenues within the motorcycle industry. Achieving the standards will require modification of carburetion systems, possible redesign of engines and/or the addition of hardware such as catalytic emission control systems. The expense incurred by the manufacturers in achieving the standards will be passed on to consumers. The extent of the pass through may vary from manufacturer to manufacturer and among product lines. This analysis assumes full pass through with development and equipment costs passed on equally for each class of motorcycle.

Sales and revenue estimates have been divided into seven classes of motorcycles and for eight manufacturing categories. In order to show the sensitivity of the industry to potential price increases two price elasticity estimates have been used. 1/ Arguments can be presented which would support either a high or low price elasticity. On the high side we have assumed unit price elasticity, i.e. 1.0. This would imply that consumers are quite sensitive to price changes. Under the 1.0 price elasticity assumption a 1% increase in the market price of motorcycles would lead to a 1% decrease in sales volume. On the low side we have assumed a price elasticity of 0.3 in which case a 1% increase in the price would result in a 0.3% decrease in sales.

The high price elasticity estimate would support the view that motorcycles are a basic form of transportation. Since the consumer has a number of choices available any change in the initial price might result in the selection of an alternative form of transportation. The 1.0 estimate is comparable to the price elasticity of demand for new car sales. 2/ The 0.3 estimate is

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1/ Price elasticity is a measure of the sensitivity of the market to price changes. A price elasticity estimate of 0.5 for example would imply that a 10% increase in price would result in a 5% decrease in unit sales.

2/ Energy and Environmental Analysis, "Gasoline Consumption Model," FEA, May 23, 1975.

based on the demand for leisure products.[1/] It implies that consumers are fairly price insensitive to price changes. The more important variable in this instance would be the person's income rather than the price of the motorcycle.

It should be recognized that neither of these estimates are the result of any rigorous attempt to test the sensitivity of consumers to product price changes. Market responses to changes in the first cost of motorcycles may vary between manufacturers and motorcycle families. For example, it might be quite reasonable to expect that purchasers of smaller motorcycles, especially those that may be purchasing their first motorcycle may be quite sensitive to price changes. They may not be sure that they will be able to get sufficient use to justify the investment and therefore are more sensitive to price changes. The opposite might be true for veteran motorcycle riders who realize its limitations but prefer it to other forms of transportation. The high and low price elasticity estimates should provide some indication as to the potential impact of the proposed emission standards.

a. Estimates of First Cost Increases

There is a wide divergency of opinion as to the impact of the proposed emission standards on the first cost of motorcycles. Since no standard exists at this time the manufacturers have only performed a limited amount of testing. In the opinion of most experts the 1978 interim standards can be met by most manufacturers across all product lines with little difficulty. The cost of complying with the regulations may vary from $20 to $40, depending on emission characteristics, development and certification costs. The small four-stroke engines currently have emission characteristics below the 1978 standards and therefore will require little or no modification.

1/ George Fisk Leisure Spending Behavior, University of Pa. Press. Philadelphia.

The proposed 1980 standards will be more difficult to attain. At a minimum attainment will require carburetion and engine modifications, and at a maximum addition of catalytic emission control systems may be required. Cost estimates range anywhere from $50 to $130 per motorcycle.

One of the major issues facing motorcycle manufacturers is whether two-stroke motorcycles will be able to attain the 1980 proposed standards. As previously stated the manufacturers have only done limited testing to date and therefore are unable to determine the extent of this problem. For the purposes of this analysis we have assumed that two-stroke engine families will attain the standards at approximately the same cost as four-strokes. As additional information becomes available it will be factored in to determine if the impact will be more or less than expected.

The other major permutation in this analysis relates to the advantage Honda has over other manufacturers. Honda's product lines are heavily weighted towards four-stroke engines and Honda may develop a stratified charge engine design to meet the 1980 standards. Cost estimates generally fall in the range of around $50 per motorcycle.

Table E-1 summarizes the cost estimates for achieving both the proposed 1978 interim standards and the 1980 standards. Three cases were assumed for the 1980 standards.

In this analysis, it has been assumed that the cost of meeting the standards does not vary with engine type or engine displacement and that this cost is passed forward to the consumer equally for each class of motorcycle. This assumption is used here since data is not available with which to quantify any likely cost differences. In general, one could expect that it may cost somewhat less to control four-stroke engines than two-stroke engines and that it may cost somewhat less to control the smaller displacement engines than the larger displacement engines. Thus, the projected relative impacts on the smaller displacement motorcycles may be exaggerated and the relative impact on the two-stroke manufacturers compared to the four-stroke manufacturers is potentially understated.

TABLE E-1

Estimated Price Increases
Associated with Achieving Motorcycle
Emission Standards

		Estimated Unit Cost Increase $
1978 Interim Standard		$ 30
1980 Final Standard		
Case 1		$ 50
Case 2		$130
Case 3	Honda	$ 50
	Others	$130

b. Industry Baseline

Tables E-2 and E-3 provide basic information on the sales of motorcycles in 1974. Table E-2 gives data on 1974 unit sales and Table E-3 shows dollar sales. The data is presented in terms of major manufacturers, engine type, and engine displacement. This data was used to estimate the baseline shown in Table E-4.

The baseline estimates represent expected sales of motorcycles in 1978 and 1980 in the absence of emission standards. The basic assumption underlying these estimates is that the only factor influencing sales and market shares will be the cost of achieving the proposed standards. No attempt has been made to project how market shares might change in response to other market forces. Such an effort would require a complete marketing analysis of the motorcycle industry, which is beyond the scope of this study and would require the employment of data which is not now available.

TABLE E-2

1974 SALES OF REGISTERED MOTORCYCLES
(10^3 MOTORCYCLES)[1/]

Type	Japanese				American	Other Domestic[3/]	Other Imports[2/]	Total of Known Sizes	Unspecified Others[4/]	Total: All Registered Motorcycles
	Honda	Suzuki	Kawasaki	Yamaha	Harley-Davidson					
2 Stroke										
<170 cc	8.7[5/]	32.2	38.2	58.7	13.4	3.0	18.8	173.0	-	173.0
170-450 cc	15.2[5/]	50.5	34.5	106.0	2.5	-	6.7	215.4	-	215.4
>450 cc	-	19.8	16.5	4.0	-	-	-	40.3	-	40.3
4 Stroke										
<170 cc	109.2[5/]	-	-	-	-	-	-	109.2	-	109.2
170-450 cc	210.3[5/]	-	14.7	-	5.1	-	.3	230.4	-	230.4
>450 cc	83.9	-	18.3	31.2	36.7	-	25.3	195.4	-	195.4
Total of Known cc	427.3	102.5	122.2	199.9	57.7	3.0	51.1	963.7	-	963.7
cc Not Given	6.5	5.9	7.4	5.2	.3	-	3.6	28.9	18.2	47.1
TOTAL	433.8	108.4	129.6	205.1	58.0	3.0	54.7	992.6	18.2	1010.8

1/ Based on Petersen's Motorcycle Buyers Guide, 1974, and 1974 Polk & Co. data on new motorcycle registrations.

2/ Includes: Benelli, BMW, Bultaco, Ducati, Hodaka, Husqvarna, Moto Guzzi, Norton/Triumph, Ossa and some mini-bike manufacturers.

3/ Includes three mini-bike manufacturers: Chaparrel, Rupp and Steen.

4/ Includes some foreign and some domestic. Distribution among various size categories is not defined by Polk data.

5/ Estimated due to 4 stroke and 2 stroke models in same size category.

TABLE E-3

SALES OF REGISTERED MOTORCYCLES
(10^6 DOLLARS)

Type	Japanese: Honda	Japanese: Suzuki	Japanese: Kawasaki	Japanese: Yamaha	American: Harley-Davidson	Other Domestic[2]	Other Imports[3]	Total of Known Sizes	Unspecified Others[4]	Total: All Registered Motorcycles
2 Stroke										
<170 cc	6.2[1]	19.1	18.8	36.3	6.8	1.2	9.6	98.0	-	98.0
170-450 cc	14.2[1]	47.9	29.6	106.3	2.0	-	7.2	207.2	-	207.2
>450 cc	-	30.2	23.9	7.6	-	-	-	61.7	-	61.7
4 Stroke										
<170 cc	59.1[1]	-	-	-	-	-	-	59.1	-	59.1
170-450 cc	223.9[1]	-	14.3	-	5.1	-	.5	243.8	-	243.8
>450 cc	154.9	-	38.0	53.9	93.3	-	62.0	402.1	-	402.1
Total Sales, Known cc	458.3	97.2	124.6	204.1	107.2	1.2	79.3	1071.9	-	1071.9
cc Not Given[5]	7.1	5.7	7.5	5.3	.5	-	5.5	26.2	20.2	46.4
TOTAL	465.4	102.9	132.1	209.4	107.7	1.2	84.8	1098.1	20.2	1118.3

1/ Honda sales for 2 strokes and 4 strokes less than 450 cc are estimates due to 2- and 4-stroke models in the 125 and 250 cc categories. Sales for these 2 sizes are divided between 2 and 4 strokes based on the ratio of models in the size category.

2/ Includes three mini-bike manufacturers: Chaparrel, Rupp and Steen. Dollar sales are estimated based on average price per unit of $400.

3/ Includes: Benelli, BMW, Bultaco, Ducati, Hodaka, Husqvarna, Moto Guzzi, Norton/Triumph, Ossa and some small mini-bike manufacturers. Dollar sales for mini-bike manufacturers are estimated based on an average price per unit of $500.

4/ Includes some foreign and some domestic. Distribution among various size categories is not defined by Polk data. Dollar sales are estimated by assuming the average price per unit is same as for all known sizes.

5/ Dollar value of "cc not given" is estimated by assuming the price per unit is the average price for all known sizes in the manufacturer's line. In the case of "unspecified others", dollar sales are based on a price per unit equal to average value of all known sizes.

TABLE E-4

BASELINE MOTORCYCLE SALES AND
REVENUE PROJECTIONS

MANUFACTURING CATEGORY
(Market Shares)

	Honda	Suzuki	Kawasaki	Yamaha	Harley Davidson	Other Domestic	Other Imports	Un-defined	Total
% Unit Sales	42.9	10.7	12.8	20.3	5.7	.3	5.4	1.8	100
% $ Sales	41.6	9.2	11.8	18.7	9.6	.1	7.1	1.8	100

MOTORCYCLE CLASS
(Market Shares)

	2-Stroke			4-Stroke			Undefined	Total
	<170cc	170-450cc	>450cc	<170cc	170-450cc	>450cc		
% Unit Sales	17.1	21.3	4.0	10.8	22.8	19.3	4.7	100
% $ Sales	8.6	18.5	5.5	5.3	21.8	35.9	4.2	100

GROWTH PROJECTIONS

	1974	1978	1980
Unit Sales/Year (10^3 Units)	1,010.8	1,283.7	1,445.4
Revenues/Year (10^6 $)	1,118.8	1,420.9	1,599.9
Average Cost ($/Cycle)	1,107	1,107	1,107

c. Projected Impact of Proposed Emission Standards

A series of tables is presented in this section which show the range of potential impact on sales and revenues. Two price elasticity estimates and four sets of price increases were employed. Table E-5 shows the assumptions used to estimate the economic impact.

TABLE E-5
ASSUMPTION USED TO
ESTIMATE THE ECONOMIC IMPACT

		Cost (Per Motorcycle)	Price Elasticity Low	High
1978 Interim Standards		$30	0.3	1.0
1980 Final Standards				
Case 1		$50	0.3	1.0
Case 2		$130	0.3	1.0
Case 3				
	Honda	$50	0.3	1.0
	Others	$130	0.3	1.0

Table E-6 shows the range of impact under the two price elasticity assumptions for the 1978 standards. The $30 overall increase in the price of motorcycles is not expected to have an appreciable impact on either the number of motorcycles sold or revenues. The smaller motorcycles may be impacted more severely primarily because the cost of achieving the standards will be proportionately greater relative to the average selling price. Unit sales in 1978 decrease by 1.0 to 2.8 percent with revenues staying constant or increasing by 1.7 percent. The apparent anomaly in volume sales decreasing but revenues increasing results from the assumption of less than unit price elasticity. If sales decrease by 1.0 percent, while the average price increases by more than 1.0 percent, revenues will also increase.

TABLE E-6

IMPACT OF 1978 EMISSION STANDARDS
ON SALES AND REVENUES

---------- MANUFACTURING CATEGORY ----------

(Market Shares)

Elasticity Assumption	Honda	Suzuki	Kawasaki	Yamaha	Harley Davidson	Other Domestic	Other Imports	Un-defined	Total
a) 0.3 Price Elasticity									
% Unit Sales	43.0	10.7	12.8	20.3	5.7	.3	5.4	1.8	
Δ From Baseline*	+.1	0	0	0	0	0	0	0	
% $ Sales	41.5	9.2	11.8	18.8	9.6	.1	7.1	1.8	
Δ From Baseline*	-.1	0	0	+.1	0	0	0	0	
b) 1.0 Price Elasticity									
% Unit Sales	43.3	10.6	12.7	20.2	5.8	.3	5.3	1.8	
Δ From Baseline*	+.4	-.1	-.1	-.1	+.1	0	-.1	0	
% $ Sales	41.6	9.2	11.8	18.7	9.6	.1	7.1	1.8	
Δ From Baseline*	0	0	0	0	0	0	0	0	

* Δ = increment

TABLE E-6 (Contd)

IMPACT OF 1978 EMISSION STANDARDS
ON SALES AND REVENUES

MOTORCYCLE CLASS
(Market Shares)

Elasticity Assumption	2-Stroke			4-Stroke			Undefined	Total
	<170cc	170-450cc	>450cc	<170cc	170-450cc	>450cc		
a) 0.3								
% Unit Sales	17.0	21.3	4.0	10.9	22.8	19.4	4.6	
Δ From Baseline*	-.1	0	0	+.1	0	+.1	-.1	
% $ Sales	8.9	18.6	5.5	5.2	21.9	35.7	4.2	
Δ From Baseline*	+.3	+.1	0	-.1	+.1	-.2	0	
b) 1.0								
% Unit Sales	16.7	21.2	4.0	11.1	22.8	19.6	4.6	
Δ From Baseline*	-.4	-.1	0	+.3	0	+.3	-.1	
% $ Sales	8.7	18.5	5.5	5.3	21.8	36.0	4.2	
Δ From Baseline*	+.1	0	0	0	0	+.1	0	

* Δ = increment

TABLE E-6 (Contd)

1978

SALES PROJECTIONS

	PRICE ELASTICITY	
	0.3	1.0
Unit Sales (10^3 Units)	1272.93	1247.69
% Δ From Baseline**	-1.0	-2.8
Revenues (10^6 $)	1444.66	1419.82
% Δ From Baseline**	1.7	0.0
Average Cost *	$1,135	$1,138
% Δ From Baseline**	2.5	2.8

* Includes the price changes that result from the shift in sales to larger motorcycles.

** Δ = increment

The changes in manufacturing shares of sales are not significant enough to discuss in detail. The smaller motorcycle classes are more heavily impacted but even in this case, the impact is relatively small.

The impact of the 1980 emission standards on sales and revenues under the three cases is shown in Table E-7. The impact on unit sales falls in the range of a 1.7 to 14.7 percent decrease with revenues falling in the range of a 1.7 percent decrease to a 7.7 percent increase. Average unit costs taking into consideration the direct cost of achieving the emission standards and the indirect impact on sales shares, increase by 4.9% to 15.2 %. Approximately two-thirds of the cost increase can be attributed to the emission control systems with the remainder associated with the shift in sales.

These estimates represent the range of potential impact. The Case 1 assumption with a price elasticity of demand of 0.3 is probably optimistic and Case 2 assumption with a price elasticity of 1.0 could be considered to be pessimistic. The more reasonable estimate is probably Case 3 falling somewhere in the range between the two elasticity estimates. Table E-8 shows the average expected impact in 1980 based on Case 3 and the range under Cases 1 and 2.

Given these assumptions unit sales would be expected to decrease by roughly 7.1 percent, revenues to increase by 2.3 and the average cost to increase by 10.1 percent.

The range of impact on individual manufacturers and classes of motorcycles is shown in Table E-9A. Because of the multiplicity of data only the average impact estimated under Case 3 is shown. As stated previously if the cost of achieving the emission standards is passed forward to the consumer equally

TABLE E-7

IMPACT OF 1980 PROPOSED EMISSION STANDARDS
ON SALES AND REVENUES

	ELASTICITY ASSUMPTION	
	0.3	1.0
Unit Sales (10^3 Units)		
Case 1	1,421.0	1,363.9
%Δ From Baseline	-1.7	-5.6
Case 2	1,381.8	1,233.4
%Δ From Baseline	-4.4	-14.7
Case 3	1,398.3	1,288.3
%Δ From Baseline	-3.3	-10.9
Revenues (10^6 $)		
Case 1	1,649.2	1,595.8
%Δ From Baseline	+3.1	-0.3
Case 2	1,723.1	1,572.3
%Δ From Baseline	+7.7	-1.7
Case 3	1,691.4	1,582.2
%Δ From Baseline	+5.7	-1.1
Average Cost ($/Unit)		
Case 1	1,161	1,170
%Δ From Baseline	+4.9	+5.7
Case 2	1,247	1,275
%Δ From Baseline	+12.6	+15.2
Case 3	1,210	1,228
%Δ From Baseline	+9.3	+10.9

TABLE E-8

AVERAGE EXPECTED IMPACT
OF 1980 PROPOSED EMISSION STANDARDS

	Average	Range
Unit Sales (10^3 Units)	1,343.3	1,233.4-1,421.0
%Δ From Baseline	-7.1	-14.7 — -1.7
Revenues (10^6 $)	1,636.8	1,572.4-1,723.1
%Δ From Baseline	+2.3	-1.7 — +7.7
Average Cost ($/Unit)	1,219.0	1,161 - 1,275
%Δ From Baseline	+10.1	+4.9 —+15.2

TABLE E-9A

IMPACT OF ACHIEVING 1980 PROPOSED
EMISSION STANDARDS ON MARKET SHARES

---------- MANUFACTURING CATEGORY ----------

	Average	% Δ From Baseline
Honda		
Unit Sales (10^3)	598	-3.5
Revenues ($10^6$$)	675	+1.4
Average Cost ($)	1129	+5.2
Suzuki		
Unit Sales	139.7	-9.9
Revenues	152.2	+3.2
Average Cost	1089	+14.8
Kawasaki		
Unit Sales	165.9	-10.5
Revenues	194.8	+3.1
Average Cost	1174	+15.2
Yamaha		
Unit Sales	266.0	-9.3
Revenues	302.6	+1.1
Average Cost	1138	+11.5
Harley-Davidson		
Unit Sales	73.8	-11.0
Revenues	157.0	+1.9
Average Cost	2127	+14.5
Other Domestic		
Unit Sales	3.4	-20.8
Revenues	1.8	+4.7
Average Cost	529	+31.9

TABLE E-9A (Contd)

IMPACT OF ACHIEVING 1980 PROPOSED
EMISSION STANDARDS ON MARKET SHARES

	Average	% Δ From Baseline
Other Imports		
Unit Sales	24.0	-8.0
Revenues	29.8	+3.1
Average Cost	1240	+11.7
---------- MOTORCYCLE CLASS ----------		
Two Stroke	Average	% Δ From Baseline
< 170cc		
Unit Sales	210.8	-14.8
Revenue	146.3	+6.3
Average Cost	694.0	+24.6
170-450cc		
Unit Sales	282.1	-8.4
Revenue	306.4	+3.4
Average Cost	1089	+13.1
>450cc		
Unit Sales	54.4	-5.6
Revenue	90.4	+2.4
Average Cost	1661	+8.5
Four Stroke		
< 170cc		
Unit Sales	146.8	-6.0
Revenues	86.8	+2.7
Average Cost	591	+9.2

TABLE E-9A (Contd)

	Average	% ΔFrom Baseline
170-450cc		
Unit Sales	317.8	-3.5
Revenues	354.4	+1.7
Average Cost	1115	+5.4
>450cc		
Unit Sales	271.1	-3.0
Revenues	583.5	+1.5
Average Cost	2152	+4.6
Undefined		
Unit Sales	60.2	-11.3
Revenues	69.0	+2.9
Average Cost	1145	+13.2

for each class of motorcycle, the smaller motorcycle will tend to lose market shares to the larger motorcycles. Table E-9A illustrates this impact. The smaller two-stroke motorcycles and manufacturers that have a large share of their sales in these classes are more likely to be adversely impacted by the costs of achieving the emission standards.

It should be noted, especially under the manufacturing category in Table E-9A that the average cost change also reflects the projected shift in sales towards the larger bikes. For example, in the case of Harley-Davidson, whose larger motorcycles sell for considerably more than their smaller motorcycles, the projected 14.5% increase in average cost does not mean that Harley-Davidson motorcycles will increase by $270 (14.5% of $2127). The largest projected first cost increase for any motorcycle is $130. The remainder reflects the effect that a shift

in sales towards the larger (more expensive) motorcycles will have on the sales-weighted average cost of all new Harley-Davidson motorcycles sold that year.

d. Total Capital Cost Through 1982

The total capital cost of compliance with the proposed motorcycle emission regulations is presented in Table E-9B. The average estimate is based on a unit cost to achieve the 1980 standards of $50 for Honda and $130 for all other manufacturers. The lower total capital cost estimate is based on $50 per unit costs for all manufacturers, and the highest estimate represents a cost of $130 per motorcycle.

Table E-9B
TOTAL CAPITAL COST THROUGH 1982
OF THE MOTORCYCLE EMISSIONS STANDARDS

Total Capital Cost (10^6\$)	Average	Range
	$502.9	$304.5 - $665.3

e. Potential Impact on Employment and Aftermarket

The level of employment within the domestic motorcycle industry has been estimated to be around 96 thousand full and part time employees. Approximately 66 percent of this labor force is employed by retail outlets. To the extent that sales decline relative to the baseline projection the growth in this industry and thereby employment will tend to increase less rapidly. It is unlikely that the existing labor force will be affected because new sales of motorcycles will continue to increase relative to sales in 1974.

The same consideration should hold for the aftermarket. Aftermarket sales of equipment will probably increase less rapidly than would have been the case in the absence of emission standards. Given the current high growth rate of around 40 percent per year the impact should be relatively small.

The most significant impact will probably be felt by the manufacturing industry. Assuming a direct relationship between output and employment, the labor force associated with the U.S. market which is directly employed by manufacturers could be reduced by 2 to 15 percent depending on the response by consumers. Since over 95 percent of this work force is located either in Japan or Europe, the impact on domestic employment will be small.

2. Consumer Costs

Consumer costs as a result of the regulations will take several forms. The increases in the price of motorcycles calculated in the previous section as a result of cost increases to the producers will be an increased first cost to the consumer. With an assumption of 100 percent pass-through of costs, the additional cost of the necessary systems will be the price increase which the consumer faces.

Besides first cost increases, changes in operating costs are also expected. For the 1978 standards, it is expected that operating costs may decrease due to the 15 percent greater fuel economy which may accompany the expected modifications. No other changes in operating costs are expected. (Current estimates of fuel economy are shown in Table E-10.) Fuel economy improvements would vary from model to model. Fifteen percent is the average expected improvement, and this average is used here in calculating total life cycle costs. A lack of

TABLE E-10
GASOLINE MILEAGE BY MOTORCYCLE
ENGINE SIZE AND TYPE[1/]

Motorcycle Model By Engine Displacement (in cc)	Miles per Gallon	
	2-stroke[2/]	4-stroke[2/]
50 - 100 cc	80	90
101 - 169 cc	60	70
170 - 300 cc	45	60
>300 cc	35	40

1/ Gasoline mileage calculated from EPA emission test data obtained using the Urban Federal Test procedure.

2/ Excludes off-road motorcycles

good data exists on exact expected fuel economy changes. The fuel economy can vary over a wide range depending upon gearing, type of use, and whether the motorcycle is used primarily on- or off-road. Fuel economy will be generally higher for street motorcycles like those being considered here, and estimated current fuel economy is assumed to be 74 mpg for motorcycles less than 170 cc and 42 mpg for motorcycles greater than 170 cc.[1/]

Based on these fuel economy figures, a price of gasoline of $.50 per gallon, and a discount rate[2/] of 10 percent per year, an estimate of the operating cost savings due to increased fuel economy has been calculated and is shown in Table E-11. A 15 percent increase in the fuel economy of small motorcycles would mean a savings of $4.90 over 5 years, $6.31 over 8 years, and $7.19 over 15 years. The Gallup data on mileage accumulation by motorcycles is used. Most of the mileage is accumulated by a motorcycles in the first years after purchase, and the average life of a motorcycle is about 5-8 years, and $7.19 over 15 years. For motorcycles larger than 170 cc, the savings in operating costs is $17.60 over 5 years, $23.11 over 8 years, and $29.87 over 15 years.

The Gallup data on mileage accumulation by motorcycles is used. Most of the mileage is accumulated by a motorcycle in the first years after purchase, and the average life of a motorcycle is about 5-8 years. Smaller motorcycles generally have shorter lives. Very few motorcycles would be expected to last 15 years. These savings in operating costs act to partially offset the increased first cost to the consumer. The life cycle cost to the consumer is the sum of the first and operating costs. Life cycle costs are used below to calculate cost-effectiveness, and it should be noted that with 1980

1/ These figures are derived from EPA fuel economy data weighted by present composition of the motorcycle population.

2/ A discount rate is used in order to translate future benefits into present dollars. A savings in operating costs of "x" dollars will mean less to the consumer in 10 years than in 2 years.

TABLE E-11

SAVINGS IN OPERATING COSTS DUE TO EMISSION CONTROLS[1/]

Number of Years of Operation	Motorcycles less or equal to 170 cc			Motorcycles greater than 170 cc		
	Total discounted cost of gasoline baseline	Total discounted cost of gasoline with control system	Savings in operating cost	Total discounted cost of gasoline baseline	Total discounted cost of gasoline with control system	Saving in operating cost
after 5 yrs.[2/]	$38.04	$33.14	$4.90	$138.96	$121.32	$17.6
after 8 yrs.[2/]	$47.43	$41.12	$6.31	$180.99	$157.78	$23.1
after 15 yrs[2/]	$54.27	$47.08	$7.19	$232.56	$202.69	$29.8

1/ All costs and savings are discounted at 10 percent per annum.

2/ Five to eight years is the average current motorcycle life. Fifteen years would be very unusual.

standards, neither savings nor increases in operating costs are expected, and life cycle costs are equal to first costs.

Another consumer cost will be in the form of possible diminished consumer choice. As will be discussed below, the extent to which product lines will be consolidated, certain manufacturers will leave the on-road market, or certain types of motorcycles will be unable to meet standards is not known. To the extent that this does occur as the result of the regulations, it will represent a reduction in the number of types of motorcycles the consumer can choose from. The worth to the consumer of a greater number of choices cannot be expressed as a dollar amount, but any reduction in choice must be viewed as an indirect cost.

3. Impacts on Competitive Structure

Any modification of a product which is required of a number of manufacturers may be expected to result in different costs for the various manufacturers involved. The cost estimates used in this analysis are average costs, and individual firms may face costs higher or lower than this average. Especially for the 1980 standards, it is possible that certain manufacturers may not be able to meet the standards for all models. The extent to which this may occur is not known at the present time due to uncertainties concerning the technology necessary to meet the 1980 standards. Both the presently higher emissions from two-stroke motorcycles and the reactions of manufacturers tend to imply that the potential for this is greater for two-stroke motorcycles. The exact ability of all manufacturers to modify four-stroke models in order to meet the standards is not known. As was shown in the characterization of the existing industry, there are wide variations between manufacturers in the 2-stroke composition of

model lines. Any special problems faced by manufacturers of a particular engine type would affect the competitive structure of the industry. Not all effects on competitive structure can be shown through an elasticity analysis of overall industry effects. This section will discuss the extent to which effects of the regulations may be different for different firms and the effect this may have on competition.

More than just composition of a manufacturer's model line with respect to size of engine and engine type will determine the cost and feasibility of meeting the standards. Company size will also be important because production costs, research and development capabilities and costs, and the number of units of production over which fixed costs may be spread are all at least partly a function of the size of the company. Small companies will generally find it harder to meet any required modifications at a cost which is competitive with larger manufacturers.

Table E-12 provides a summary of the competitive advantages individual manufacturers may have in areas which will be relevant to the changes necessary to meet the proposed regulations. Ability to meet the standards will not necessarily correlate perfectly with either size or nature of product line alone. Table E-12 should not be considered to be a perfect quantification of ability to meet the proposed standards. Rather, it should be viewed as a convenient summary of the advantages which certain companies may have in areas relevant to emission control technology. A consequence of these regulations is that they may have potentially disruptive effects upon the competitive structure of the industry. Some manufacturers may be more heavily impacted than others.

TABLE E-12

ASSESSMENT OF COMPETITVE POSITION OF INDIVIDUAL MANUFACTURERS WITH RESPECT TO THE KEY DETERMINANTS OF IMPACT OF REGULATIONS UPON INDIVIDUAL COMPANIES

Manufacturer	Factor/Consideration[1/]						
	1	2	3	4	5	6	7
Honda	+++	++++	+	---	++++	++	++++
Yamaha	++	--	-	-	++++	++++	+
Kawasaki	+	--	-	--	++++	++++	+
Suzuki	+	----	--	---	++++	++	++
Harley-Davidson	--	+++	++	--	-	+++	--
Norton/Triumph	---	++++	++++	--	--	-	-
BMW	----	++++	++++	+	+++	++	+++

1/ Factor/Consideration refers to the following, which is more fully explained in the text.

1. Production Volume
2. 2-stroke vs. 4-stroke
3. Product Line Emphasis, displacement size
4. Number of Engine Displacement Sizes
5. Production Methods
6. Size of Parent Company
7. R&D Efforts, Progress to Date

N.B. The plusses and minuses are evaluations based on knowledge of companies but many of the areas involve competitive advantages which are not easily quantifiable. The seven areas are not all of equal importance.

In assessing the impact of the 1980 emission standards upon the relative competitive positions of various manufacturers, a number of factors must be considered:

1) levels of production: high volumes enable economies of scale and lower unit costs of amortized fixed expenses associated with research and development and certification requirements;
2) 2-stroke vs. 4-stroke: emphasis of a manufacturer's current product line; heavy reliance upon the 2-stroke engine type might represent a competitive disadvantage. The severity of the disadvantage will depend upon the difficulty which 2-strokes have meeting standards relative to 4-strokes;
3) engine displacement size: in light of the lower percent cost increases for larger and more expensive motorcycles, manufacturers of only large bikes, with the exception of larger 2-strokes, might have a competitive advantage;
4) number of engine families in current line: a limited number of engine families (partially related to number of displacement size categories) to be certified could be a potential advantage;
5) production methods: A higher volume assembly line production method would probably be an advantage in instituting any required modification. A more job-oriented production method would be expected to entail greater costs of tooling;
6) size of the parent company: for example, the financial resources available and the company's ability to absorb the emission control costs;
7) R&D progress made to date: including previous experience which will yield carryover benefits such as overlap with automobile emissions technology.

Table E-12 shows the competitive advantage expected to be held by Honda in nearly every area. Among the big four Japanese companies, Suzuki finds itself in the least advantageous position with Yamaha and Kawasaki somewhere between Suzuki and Honda. BMW shows considerable strength in most areas considered, with the exception of production volume. Harley-Davidson is felt to be in a somewhat weaker position on the basis of comparison with other firms in the areas considered.

This table shows a number of factors which need to be considered when evaluating the effect of the regulations on producers. Other factors which are important but not quantifiable even to the extent of Table E-12 include engineering capability, exact level of emissions of current models, and pricing strategies of companies.

4. Special Impacts - Small Firms

A similar table for all of the many small manufacturers would be impossible due to limited information about many of these companies. Table E-13 provides for some of the small and medium-sized manufacturers the following information: 1) total unit volume accounted for by sales to the street bike market, and 2) the number of engine size categories (in their respective current product lines) that exceeded 1,000, 2,000 and 5,000 unit sales for 1974. The table gives an idea of the number of units over which the fixed costs associated with emissions R&D, certification and durability testing can be amortized.

TABLE E-13

PRODUCTION OF SOME SMALL AND MEDIUM-SIZED MANUFACTURERS

Manufacturer	1974 Total New Registrations	No. of Engine Sizes in Current Product Categories	No. of Engines for which New Registrations Exceeded		
			1000	2000	5000
Harley-Davidson	57,929	9	7	7	4
Norton/Triumph	13,891 1/	3	3	2	1 1/
BMW	9,039	3	3	2	0
Moto Guzzi	2,717	1	1	1	0
Jawa	3,754	6	1	0	0
Benelli	1,970	6	0	0	0
Ducati	971	4	0	0	0

1/ 1974 sales are significantly lower than prior years as a result of production delays of Triumphs. Total volume normally would have approached 20,000-25,000. Whether this low sales volume is a permanent situation or not is unknown.

SOURCE: R. L. Polk, 1974 New Registrations, U.S. Summary.

Small volume motorcycle manufacturers will probably not be able to perform their own durability mileage accumulation and emission testing. The added problem of fewer units over which to spread the costs could mean that certification costs would cause a relatively large increase in the price of a small manufacturer's product. This could bring about severe impacts on their sales and competitive position.

EPA estimates of certification costs for manufacturers of a motorcycle larger than 170 cc are $48,600 for durability testing and $9,400 for emission data testing. For motorcycles less than 170 cc, the cost of durability testing is estimated to be $28,700 and the cost of emission data testing $7,800. These are costs for testing one vehicle in an engine family, and include the costs of manufacturing the prototype vehicle, mileage accumulation, maintenance and emission testing.

For the four large Japanese manufacturers, the cost of certification per motorcycle ranges from $0.99 for Honda to $2.94 for Suzuki. The average cost for these four manufacturers is .145 percent of retail price. EPA estimates that the economic impact of full certification on small volume manufacturers would be 3 to 6 percent of retail price for manufacturers of less than 10,000 units.

As a result of these considerations, the proposed regulations provide that the manufacturers of less than 10,000 unit sales may request reductions in the number of certification test vehicles. When appropriate, EPA plans to respond to such requests by eliminating durability testing for manufacturers below 10,000 unit sales and also reducing emission data testing for manufacturers below 2,000 unit sales. EPA estimates are that the cost will thereby be reduced to .2 to .4 percent of retail

price for manufacturers of less than 10,000 units and .6 to 1.0 percent for manufacturers of less than 2,000 units. These certification costs are considerably closer to those of the large manufacturers on the basis of percent of retail price.

5. Impacts on Product Lines

Table E-14 presents a concise product line analysis for manufacturers of full-sized motorcycles. It is an elaboration of the characterization of small manufacturers which was presented as part of the description of the current industry. It enumerates which manufacturers are supplying which segments of the market. The large Japanese firms have wide product line coverage, but a number of manufacturers make products intended exclusively for off-road use. This is the case of Maico, MZ, Greeves and others included in the "trail model" category. Consequently, these manufacturers will be unaffected by the emissions standards.

On the other hand, manufacturers such as BMW, Ducati, Laverda, Motobecane, Moto Guzzi, and MV Augusta, because of their exclusive street bike product orientation, could potentially be adversely affected. A fairly large number of small manufacturers sell motorcycle lines which are aimed primarily at the off-road market, but which include some dual purpose models and may therefore be affected. The dual purpose motorcycle has both street and off-road capabilities. For the individual models in Table E-15, it is difficult to determine the extent to which the consumer buys and rides a particular model for on-road use.

TABLE E-14

PRODUCT LINE ANALYSIS - MODELS WHICH ARE STREET MOTORCYCLES[1/]

Manufacturer	Mini-bikes/ cycles	Off-road & racing - all sizes	Street/trail (cc)			Street (cc)			
			<175	175-400	>400	125-175	250	350-600	650+
Full-Line									
Honda	9	2	1	1		4	3	4	1
Yamaha	4	7	3	4	1	1	1	2	1
Suzuki	7	3	1	2		1	1	3	1
Kawasaki	5	3	1	1	1	1	1	2	2
Benelli	5		2				2	1	2
Harley-Davidson	1		3	1				1	5
Street-Line									
Norton/Triumph		1	1		1			1	7
BMW								1	3
Ducati									3
Laverda							1		4
Motobecane								1	
Moto Guzzi									3
MV Agusta									1
Trail Line									
includes 32 manufacturers[2/]	21	67	26	10	0	2	4	1	0

1/ This table gives number of models and will not necessarily indicate sales importance.

2/ Of these 32 manufacturers, 27 make no models which are strictly street motorcycles. None of the other 5 has more than 2 street models each.

For those dual purpose models for which street usage is not an important consideration for the prospective buyer, the emission standards and requirements may adversely affect sales. At the present time, a person who purchases a motorcycle for off-road use may buy a dual purpose motorcycle so that he may have the convenience of riding it on the street occasionally. However, if such a motorcycle were to become more expensive due to the proposed emission regulations, he might buy a strictly off-road motorcycle if it had a lower price.

For virtually all of the brands listed under the category of "Trail Model Manufacturers", sales volumes are quite small. Also, with few exceptions, these manufacturers are small companies which may not in all cases have the capability to meet the emission requirements. The sales volume that many of these companies currently derive from the street bike market in the United States is of such a small magnitude that they may withdraw from this segment of the market and concentrate entirely on the off-road market. The extent of this impact is uncertain due to a lack of knowledge about the extent to which these companies can either develop or buy (from other engine producers) the systems necessary to meet the proposed standards. European and other foreign producers for whom the United States is only a minor market may at least temporarily stop supplying their street motorcycles to the United States.

For both large and small producers, emission control requirements will probably, at least in the short run, lead to consolidation of product lines. This will occur partially to avoid spreading engineering manpower, and partially, in the case of small manufacturers, to reduce certification costs. Sales of dual purpose motorcycles may be affected due to the fact that some buyers most interested in the off-road aspect of the motorcycle may not want to pay extra money for a machine which has been modified in order to meet emission requirements for street machines. For many riders, however, the street use capabilities of the dual purpose motorcycle will remain important.

As a result of the regulations, product line shifts may occur which will involve not only the proportions of street, combination and off-road motorcycles, but also the mix of two- and four-stroke engines. For 1980 standards, uncertainty about the technology necessary for emission control makes the extent of changes in mix of engine types uncertain. Presently higher emissions from two-strokes, and the reactions of manufacturers suggest that two-strokes may be more difficult to modify than four-strokes.

In an extreme case where a company would have to convert its two-stroke line to four-stroke engines, large capital outlays may be required. In its response to the ANPRM, Suzuki estimated a total investment of $64,673,000 to convert all 17 of its 2-stroke models to 4-stroke engines.[1/] Suzuki also estimated

1/ Suzuki supplemental comments to the Advance Notice of Proposed Rule Making, September 4, 1974.

the extent of losses in sales associated with a transition period where it would not be able to offer motorcycles in the American market. The Suzuki estimate should be viewed as a "worst case" estimate, but during any conversion period, drastic market share erosion could be experienced, followed by a difficult struggle to recoup losses. Lost brand loyalty and disruption to the company's distributor/dealership network would dictate at best a slow recovery to previous market share position. The exact probability of such extreme effects cannot be quantified. Lead times necessary for technological development are not certain. It is believed that most motorcycles can meet short term emission standards, and it is for the proposed 1980 emission levels that these issues are possibly relevant.

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F. Cost-Effectiveness of Proposed Regulations

Cost-effectiveness of various control techniques can be best expressed in terms of the kilograms of pollutants controlled per dollar expended on the techniques. Cost-effectiveness calculations of this type have been done for various hydrocarbon and CO control techniques and are shown in Table F-1. The techniques considered are inspection and maintenance (I/M), Vacuum Spark Advance Disconnect (VSAD) retrofit, air bleed to the intake system retrofit, and catalyst retrofit for light duty vehicles, and gasoline station HC evaporative emission controls.

In order to compare the proposed regulations for motorcycle emission controls with these other programs, similar calculations have been done for motorcycles. These are shown in Tables F-2 and F-3 for hydrocarbon and carbon monoxide control. It should be noted that the motorcycle modifications being considered will yield reductions in both pollutants. However, it is not possible to determine the cost of controlling only one of the pollutants. Therefore, in calculating cost-effectiveness, the fuel price of the emission control system has been used as the cost of controlling hydrocarbons and also as the cost of controlling carbon monoxide. It should also be noted, as discussed earlier, that the assumption that the cost of meeting the standards will be the same for two-strokes and for four-strokes and the same for small displacement as for large displacement is used only because of insufficient data with which to quantify the likely differences. In general, it will probably cost less to control the smaller displacement motorcycles and less to control four-strokes than two-strokes. Thus, the cost-effectivness of controlling the less than 170 cc two-stroke motorcycles and greater than 170 cc four-stroke motorcycles is

Table F-1

COST-EFFECTIVENESS OF EMISSION CONTROL TECHNIQUES:
Light Duty Vehicles and Gasoline Station Controls[1/]

Technique	Date of Program Implementation 1977	1980
HC Control		
I/M (all cars)	.69 (3.6%)[2/]	.23 (1.5%)
Catalyst ('72-'74)	.75 (3.77%)	.55 (3.0%)
Catalyst ('68-'74)	.80 (5.5%)	.52 (3.6%)
Air Bleed (pre-'68)	2.32 (1.0%)	2.2 (.5%)
VSAD (pre-'68)	2.92 (1.2%)	3.53 (.6%)
Gasoline Station Controls	4.51 (7.1%)	4.89 (9.6%)
CO Control[3/]		
I/M	7.41 (7.7%)[2/]	3.72 (6.3%)
Catalyst ('72-'74)	8.45 (8.4%)	6.41 (9.2%
Catalyst ('68-'74)	10.45 (14.5%)	6.55 (11.8%)
VSAD (pre-'68)	13.45 (1.1%)	17.27 (.7%)
Air Bleed (pre-'68)	82.00 (7.1%)	81.45 (4.9%)

1/ All figures are kilograms of pollutants controlled per dollar expended on the device (i.e. higher values are more cost-effective).

2/ Figures in parentheses show the reductions in emissions from the implementation of each control technique.

3/ Based on an AQCR with 5% stationary source contribution such as Seattle, Phoenix and Minneapolis.

Source: The Clean Air Act and Transportation Controls - An EPA White Paper
(Adjusted to 1974 dollars and converted to kilograms.)

Table F-2

COST EFFECTIVENESS OF HYDROCARBON[1] CONTROL FOR MOTORCYCLES

	2 Stroke ≤ 170cc[2]		2 Stroke > 170cc[3]		4 Stroke ≤ 170cc[2]		4 Stroke > 170cc[3]	
	Kg Controlled Over Life of Cycle[4]	Kg Controlled Per Dollar Spent	Kg Controlled Over Life of Cycle[4]	Kg Controlled Per Dollar Spent	Kg Controlled Over Life of Cycle[4]	Kg Controlled Per Dollar Spent	Kg Controlled Over Life of Cycle[4]	Kg Controlled Per Dollar Spent
1978 Standard Assumed first cost of $30 and 15% fuel economy increases[5]	36	1.43	133	19.30	—[6]	—[6]	—[6]	—[6]
1980 Standard Assumed incremental first cost of $20[7]	57	2.85	235	11.75	10.2	.51	46.5	2.33
1980 Standard Assumed incremental first cost of $100[7]	57	.57	235	2.35	10.2	.10	46.5	.47

1/ Costs given are for modifications that will control both hydrocarbons and carbon monoxide. It is not possible to determine the cost of controlling only one pollutant.

2/ for motorcycles ≤ 170cc, assumed life is 5 years.

3/ for motorcycles > 170cc, assumed life is 8 years.

4/ kilograms controlled are based on reductions in pollutant due to respective standard and 12,000 Km driven for cycles less than 170cc and 30,000 Km for cycles greater than 170cc.

5/ Discounted fuel savings are $4.90 (≤ 170cc) and $23.11 (> 170cc).

6/ for 4 stroke motorcycles, no modifications will be necessary to meet 1978 HC standards.

7/ First cost estimates for 1980 standards range from $50 to $130. Incremental costs are used, and account for $30 spent per motorcycle to meet 1978 standards.

Table F-3

COST EFFECTIVENESS OF CARBON MONOXIDE[1] CONTROL FOR MOTORCYCLES

	2 Stroke <170cc[2]		2 Stroke >170cc[3]		4 Stroke <170cc[2]		4 Stroke >170cc[3]	
	Kg Controlled Over Life of Cycle[4]	Kg Controlled Per Dollar Spent	Kg Controlled Over Life of Cycle[4]	Kg Controlled Per Dollar Spent	Kg Controlled Over Life of Cycle[4]	Kg Controlled Per Dollar Spent	Kg Controlled Over Life of Cycle[4]	Kg Controlled Per Dollar Spent
1978 Standard Assumed first cost of $30 and 15% fuel economy increases[5]	—[6]	—[6]	165	23.95	—[6]	—[6]	165	23.95
1980 Standard Assumed incremental first cost of $20[7]	86.4	4.32	447	22.35	86.4	4.32	447	22.35
1980 Standard Assumed incremental first cost of $100[7]	86.4	.86	447	4.47	86.4	.86	447	4.47

1/ Costs given are for modifications that will control both hydrocarbons and carbon monoxide. It is not possible to determine the cost of controlling only one pollutant.

2/ for motorcycles <170cc, assumed life is 5 years.

3/ for motorcycles >170cc, assumed life is 8 years.

4/ Kilograms controlled are based on reductions in pollutant due to respective standard and 12,000Km driven for cycles less than 170cc and 30,000 Km for cycles greater than 170cc.

5/ Discounted fuel savings are $4.90 (<170cc) and $23.11 (>170cc).

6/ for motorcycles <170cc, no modifications will be necessary to meet 1978 CO standards.

7/ First cost estimates for 1980 standards range from $50 to $130. Incremental costs are used, and account for $30 spent per motorcycle to meet 1978 standards.

likely to be higher than shown in Table F-2, and the cost-effectiveness of controlling less than 170 cc four-stroke engines is likely to be considerably higher than shown in Tables F-2 and F-3. Nevertheless, lacking the data with which to quantify these likely differences, the following conclusions are based on the numbers shown in Tables F-2 and F-3.

Cost-effectiveness conclusions depend significantly on the cost estimate used for the uncertain 1980 time frame. A cost of $130 in 1980 means that control of motorcycles for HC alone would not be cost-effective for motorcycles less than 170 cc when compared to the light duty vehicle measures being considered. For motorcycles larger than 170 cc, control of HC alone would be less cost-effective than the LDV measures in Table F-1 for 4-stroke motorcycles, but more cost-effective than all measures but gasoline station controls and VSAD for large 2-strokes.

For CO control in 1980, the $130 cost estimate would make CO control less cost-effective than the LDV measures for both engine types less than 170 cc. Control of large motorcycles at this $130 cost would make the control of CO more cost effective than I/M for light duty vehicles, but less cost effective than the other LDV control measures.

With the lower cost estimate of $50 in 1980, the cost effectiveness of controlling small 4-stroke motorcycles for HC is still less than any of the LDV measures. Control of large 2-strokes becomes more cost effective than any of the LDV measures considered, and the control of small 2-stroke and large 4-stroke motorcycles becomes cost effective relative to some, but not all of the HC control techniques for LDV's.

Control of CO in 1980 with a cost of $50 implies that control of motorcycles less than 170 cc is less cost effective than the measures in Table F-1, with the exception of I/M. Control of CO for large motorcycles in 1980 is more cost effective than all LDV measures except air bleed with a cost of $50.

For 1978 standards, a first cost of $30 is partially offset by a 15 percent decrease in fuel consumption. No modifications will be necessary to meet CO standards for motorcycles less than 170 cc or HC standards for 4-stroke motorcycles. Control of motorcycle HC emissions for large 2-strokes in 1978 is more cost effective than any of the measures in Table F-1. Control of HC alone for small 2-strokes is less cost effective than catalysts. CO controls on motorcycles larger than 170 cc is more cost effective than all techniques in Table F-1 except air bleed for LDV's.

G. Impacts of Alternative Regulatory Programs

1. Alternative Standards for Motorcycle Emission Regulations

The proposed standards and several alternatives are described in Table G-1. One alternative is obviously not to promulgate any regulation. This alternative could adversely impact the industry if California bans motorcycle operation during daylight hours in the summer as provided in the California Transportation Control Plans (38 F.R. 31246, November 12, 1973) contingent upon the absence of Federal motorcycle regulations by January 1, 1976. It would also mean no reductions in motorcycle emissions in the rest of the United States.

Alternative I in Table G-1 includes a tighter phase-in standard than the proposed action, and Alternative II a less stringent phase-in limitation. Alternative III reflects less stringent long-term emission standards, equivalent to those for automobiles in 1977.

Alternative I, which would set the 1978 HC phase-in standard at 5 g/km and Alternative II, which would set the phase-in HC standard at 8 g/km, are both likely to prevent certification of certain large 2-stroke motorcycles. The technical opinion of EPA is that if the 5 g/km standard were implemented, it would mean that all 2-stroke engines over 350 cc would not meet the standards, and if the 8 g/km standard were implemented, 2-stroke motorcycles at or above 550 cc would not meet the standards. The short term economic impact of these alternative phase-in standards could be significant.

Thirty-one percent of Suzuki's unit sales are of 2-stroke motorcycles with displacement greater than 350 cc. On a dollar

TABLE G-1

SCENARIOS FOR ALTERNATIVE
MOTORCYCLE EMISSIONS REGULATIONS

BASE CASE	- No regulations promulgated, motorcycle emissions remain uncontrolled.
PROPOSED STDS.	- Set phase-in standards of 5 grams per kilometer for $\leq$ 170 cc, 14 grams per kilometer for $\geq$ 750 cc with linear scale between 170 and 750 cc with CO at 17 grams per kilometer and NO_x at 1.2 grams per kilometer. Set 1980 standards at statutory HC, CO and NO_x levels for LDV.
ALTERNATIVE I	- Set same phase-in standards and 1980 standards as proposed except replace HC phase-in standard with single level HC standard of 5 grams per kilometer.
ALTERNATIVE II	- Set phase-in standards and 1980 standards as proposed except replace proposed HC phase-in standard with single level standard of 8 grams per kilometer.
ALTERNATIVE III	- Set same phase-in standards as proposed but set stringent 1980 standards of .93 grams per kilometer HC, 9.3 grams per kilometer CO, and 1.2 grams per kilometer NO_x (same standards as required for 1977 light duty passenger vehicles as a result of the Administrator's Suspension Decision of March 5, 1975).

volume basis, the higher cost of these motorcycles makes them even more important as a percentage of total sales. Kawasaki, Yamaha and a number of other smaller producers of large 2-stroke motorcycles would also suffer losses, although on a percentage basis they could, in more cases, be less than Suzuki's losses.

With these alternative phase-in standards, total reductions in industry sales would not be as significant as disruption of the competitive structure of the industry. Four-stroke motorcycles are, to a large extent, substitutes for two-stroke motorcycles in the eyes of many consumers. Any disappearance of large 2-stroke motorcycles would most likely mean that four-stroke manufacturers (subject to production capability constraints) would attempt to increase production and fill the gap in sales. The competitive advantage for 4-stroke manufacturers is great in the case of any regulation which causes the loss of a large portion of the 2-stroke manufacturers' lines. The large 2-stroke production category is not significant for Honda, but is of great importance to both Suzuki and Kawasaki.

The differential economic impact of Alternative III (which has much less stringent long-term standards) versus the Proposed Action cannot be assessed at this time. As has been indicated previously in this assessment, little is known about the kind of control hardware which might be used to achieve the proposed long-term standards, and although it is true that the long-term standards set forth in Alternative III would be more easily met than the proposed standards, it is not clear at this time that any cost or performance benefits would be derived from setting the less stringent long-term standards.

2. Further Regulation of Alternative Emission Sources

On March 5, 1975, Administrator Train of EPA announced the interim automotive emission standards for the 1977 model year and recommended the delay of statutory automotive emission standards to 1982 in light of the automotive sulfates emission problem. In light of continuing difficulties in achieving the oxidant and carbon monoxide air quality standards in major urban areas and the fact that the more stringent automotive emission standards may be delayed, EPA is taking a new look at the potential for further reduction of alternative emission sources of hydrocarbons and carbon monoxide.

During the same March 5th press conference, Administrator Train announced several actions designed to provide additional reductions in emissions of hydrocarbons and carbon monoxide from other sources. The actions include:

"1) More stringent emissions will be proposed for heavy duty vehicles.

2) A new evaporative emission standard for automobiles will be proposed for the 1978 model year.

3) Existing standards requiring a 90 percent reduction in hydrocarbon emissions during vehicle refueling must result in use of the most effective control devices which are available or can be developed.

4) EPA will re-examine current regulations providing for hydrocarbon control from paints, solvents, dry-cleaning liquids, and refineries with a view to tightening them."

Further control of other emission sources is not an alternative to motorcycle emission standards but complements these standards as a part of EPA's overall program to improve air quality.